

1997

The Use of Forensic DNA in Criminal Cases in Kentucky as Compared with Selected Other States

Judith E. Lewter
University of Kentucky

Follow this and additional works at: <https://uknowledge.uky.edu/klj>

 Part of the [Science and Technology Law Commons](#)

Right click to open a feedback form in a new tab to let us know how this document benefits you.

Recommended Citation

Lewter, Judith E. (1997) "The Use of Forensic DNA in Criminal Cases in Kentucky as Compared with Selected Other States," *Kentucky Law Journal*: Vol. 86 : Iss. 1 , Article 7.
Available at: <https://uknowledge.uky.edu/klj/vol86/iss1/7>

This Note is brought to you for free and open access by the Law Journals at UKnowledge. It has been accepted for inclusion in Kentucky Law Journal by an authorized editor of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

The Use of Forensic DNA in Criminal Cases in Kentucky as Compared with Selected Other States

BY JUDITH E. LEWTER*

INTRODUCTION

The use of technology to examine DNA¹ strands in biological and medical fields has been around for many years, but its development in the area of forensic science began in the mid-1980s by the Federal Bureau of Investigation ("FBI").² The first case in which DNA was used by the FBI in the United States was in December, 1988. By the middle of 1989, however, after much publicity involving DNA, serious questions began to be raised in various scientific, legal, and forensic communities about its reliability and validity.³

Part I⁴ of this Note discusses some of the technical aspects of DNA typing, or "DNA fingerprinting" as it is sometimes inaccurately called,⁵

* J.D. expected 1998, University of Kentucky. The author wishes to thank the Fayette County Legal Aid Society for the use of its Resource Library. Also, special thanks to L. Skunk.

¹ Deoxyribonucleic Acid. BLACK'S LAW DICTIONARY 480 (6th ed. 1990).

² See NATIONAL RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE 1 (1992). This Note will deal exclusively with the use of DNA in criminal cases, since its use in civil cases, mostly paternity cases, does not involve the same problems and constitutional issues, nor the same admissibility issues. See also *J.E.B. v. State*, 606 So.2d 156 (Ala. Civ. App. 1992), *rev'd on other grounds*, 511 U.S. 127 (1994).

³ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 1.

⁴ See *infra* notes 11-58 and accompanying text.

⁵ The term "DNA fingerprinting" generally is used incorrectly in the United States, since DNA fingerprinting refers specifically to a certain technique in the analysis of DNA which is not often used in this country. See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 4. The term is also incorrect in the sense that it is undoubtedly a subtle attempt to borrow from the credibility of true fingerprint identification to bolster its own credibility, although there are considerable major differences in the identification techniques involved. See *id.*

and its inextricable symbiotic brother,⁶ population genetics and the "product rule."⁷ Part II⁸ discusses the legal requirements for the introduction of scientific testimony in general, and DNA in particular, in criminal cases. Part III⁹ focuses on technical problems associated with the admissibility of DNA evidence and the statistical probabilities garnered from population genetics. Finally, Part IV¹⁰ discusses how Kentucky and selected other states have come to grips with the issues involved.

I. WHAT IS FORENSIC DNA TECHNOLOGY?

A. *In General*

DNA is the active substance in all genes, carrying "the coded messages of heredity in every living thing: animals, plants, bacteria, and other microorganisms."¹¹ Forensic DNA is the application of the use of DNA to legal issues, particularly for identification purposes. The DNA makeup of every human is unique, with the exception of identical twins.¹² Each strand of DNA from the chromosome set of a single cell is approximately 1.5 meters in length. Since there are 100 trillion cells in the human body, there are ninety-three billion miles of DNA in each person, which equates to approximately 1000 times the distance from the Earth to the sun.¹³

It is impossible to compare such great lengths of DNA to each other. And yet, since each 1.5-meter strand in each chromosome is repeated throughout all of the cells, if only that portion (1.5 meters) could be compared with another source, any match would be absolute. However, even that type of comparison cannot presently be done. Currently, only

at 112-13.

⁶ The National Research Council has stated that it is meaningless to say that two DNA patterns match without stating the frequency in which such a match could occur by random chance. *See id.* at 9.

⁷ *Id.* at 76.

⁸ *See infra* notes 59-101 and accompanying text.

⁹ *See infra* notes 102-80 and accompanying text.

¹⁰ *See infra* notes 181-258 and accompanying text.

¹¹ NATIONAL RESEARCH COUNCIL, *supra* note 2, at 2.

¹² *See id.* at 3, 74.

¹³ *See* Roger Kahn, *An Introduction to DNA Structure and Genome Organization*, in *FORENSIC DNA TECHNOLOGY* 25, 26 (Mark A. Farley & James J. Harrington eds., 1991).

a very tiny portion of a strand is compared with a similar section from another source in order to determine if the two samples could have come from the same source. A negative match is absolute. That is, if the laboratory finds that two samples are dissimilar, the inescapable conclusion is that they do not match and so are not from the same source.¹⁴

If there is a match between the two samples, it is necessary to compute the probability of such a match occurring between samples taken from randomly chosen sources.¹⁵ If the probability of a random match is determined to be sufficiently low, the match is strong evidence that the two samples came from the same person, rather than being a mere coincidence.¹⁶ Thus, the prosecution would argue, the person whose DNA sample matches the crime scene sample is guilty of the crime being investigated. Sometimes, however, the probability of a random match is not so persuasive, as in the New York City bombing of the World Trade Center; three percent of the population could have shared the same DNA characteristics as those in the sample of saliva found on an envelope that had been licked. This computed probability narrowed the group of potential suspects to just over 330,000 people in New York City alone, including the defendant, who could have been the source of the saliva. This obviously was not a powerful piece of evidence.¹⁷

B. Techniques for Analyzing and Identifying Samples of DNA

1. Restriction Fragment Length Polymorphisms ("RFLP")

The most commonly used method to compare DNA samples is called the Restriction Fragment Length Polymorphisms test, generally referred to as RFLP. This test requires a larger sample¹⁸ than other methods used

¹⁴ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 9, 74-75.

¹⁵ See discussion *infra* notes 50-58 and accompanying text.

¹⁶ In some cases the odds of a random match have been estimated at one in many millions, or even billions. See, e.g., *Martinez v. State*, 549 So.2d 694 (Fla. Dist. Ct. App. 1989) (one in 234 billion); *Andrews v. State*, 533 So.2d 841 (Fla. Dist. Ct. App. 1988) (one in more than 800 million); *Spencer v. Commonwealth*, 384 S.E.2d 775 (Va. 1989) (one in 135 million blacks).

¹⁷ See Ronald S. Ostrowski, *PCR, DQ α , and Polymarkers: A New Generation of Forensic DNA Profiling*, TRIAL BRIEFS 24-25 (Winter 1994-95).

¹⁸ Compare Thomas M. Fleming, Annotation, *Admissibility of DNA Identification Evidence*, 84 A.L.R. 4th 313, 320 (1991) (stating that a sample of blood the size of a quarter, or a sample of semen the size of a dime, would be

to compare DNA samples,¹⁹ but gives a better probability of a match. RFLP takes advantage of the fact that each strand of DNA is composed of strings of four types of nucleotides, commonly represented by the letters A, C, G, and T, that occur in different combinations and lengths.²⁰ Stated in the simplest terms, RFLP involves extracting a sufficient quantity of DNA from the samples to be compared and then analyzing the combinations of A, C, G, and T bases, along with the lengths of each base,²¹ in a seven-step process.²²

The first step is the extraction of the DNA from the tissue sample and its purification by the addition of certain chemicals. Once the DNA is separated and purified, certain enzymes, called restriction enzymes, are added to the DNA. These enzymes cut the DNA strands at certain points by recognizing specific sequences of base pairs. The lengths of these resulting fragments of DNA vary in each individual.²³

Next is a critical step called electrophoreses,²⁴ where the fragment lengths of DNA are placed parallel to each other in separate tracks at one end of an agarose gel. A positive electrode is placed at the other end of the gel. Since the DNA strands carry a negative charge, they move toward the positive charge. Since shorter fragments travel faster than longer fragments, the technician can determine the length of a fragment by how far it travels through the gel in the allotted time.²⁵

needed for RFLP tests); Margann Bennett, Comment, *Admissibility Issues of Forensic DNA Evidence*, 44 U. KAN. L. REV. 141, 146 (1995) (citing U.S. CONGRESS, OFFICE OF TECHNOLOGY ASSESSMENT, *Genetic Witness: Forensic Uses of DNA Tests* 47 (1990)) (stating that a sample of blood the size of a dime, or a sample of semen the size of an eraser, would be needed for RFLP analysis).

¹⁹ One such method is the Polymerase Chain Reaction test. See discussion *infra* notes 43-49 and accompanying text.

²⁰ There are approximately three billion nucleotides in each set of 23 chromosomes. See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 3. The letters A, C, G, and T stand for the bases adenine, cytosine, guanine, and thymine, respectively. See *id.* at 2.

²¹ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 3-4.

²² For a more detailed and technical discussion of the procedure, see Fleming, *supra* note 18, at 320-22, and Janet C. Hoeffel, Note, *The Dark Side of DNA Profiling: Unreliable Scientific Evidence Meets the Criminal Defendant*, 42 STAN. L. REV. 465, 471-74 (1990).

²³ See Bennett, *supra* note 18, at 146-47.

²⁴ See *infra* notes 102-35 and accompanying text for a discussion of possible problems associated with this step.

²⁵ See Bennett, *supra* note 18, at 147.

The results of the procedure thus far cannot be seen, so a fourth step is necessary to help make the fragments of DNA visible. A process called Southern blotting, or Southern transfer, is used to transfer the fragments from the gel to a nylon membrane. This is called a blot. At the same time, a chemical is used to split the base pairs on each fragment in half, lengthwise. This process is akin to unzipping a zipper.²⁶

The fifth step, hybridization,²⁷ involves locating various VNTRs²⁸ on the blot.²⁹ To determine these locations, the nylon blot is dipped in a solution of single-stranded³⁰ radioactive probes³¹ that have been chemically engineered to band with an identical sequence of base pairs in the sample. This has the effect of placing a recognizable mark at each location. The blots are then cleaned of any unbonded probes.³²

In order to analyze the results, the nylon blot is then placed on a piece of x-ray film and left for a period of time, from a few hours to several days.³³ The radioactive probes expose the film, creating a picture that has been described as superficially resembling the bar graphs on items in a grocery store.³⁴ This is called an autoradiograph,³⁵ or autorad for short. The probes show up as black bands on the autorad, and since they are interlocked with the VNTRs, the location and size of the VNTRs can be found.³⁶

The next step is the comparison of the bands on the tracks created from the crime scene sample with the bands on the tracks created from the sample from the suspect (the "otherwise known" sample).³⁷ If the location and distribution of the bands on the tracks are not the same,

²⁶ See *id.* at 147-48.

²⁷ See *id.* at 148.

²⁸ VNTR stands for Variable Number of Tandem Repeats. See Leonard J. Deftos, Daubert & Frye: *Compounding the Controversy Over the Forensic Use of DNA Testing*, 15 WHITTIER L. REV. 955, 961 (1994).

²⁹ VNTRs are small segments of base pairs in the DNA that are tandemly attached and repeated frequently. See Bennett, *supra* note 18, at 145.

³⁰ See *id.* at 148.

³¹ See Deftos, *supra* note 28, at 961 (the average test consists of three to four probes, each producing six to eight bands).

³² See Bennett, *supra* note 18, at 148.

³³ See *id.*

³⁴ See Deftos, *supra* note 28, at 961.

³⁵ See *id.*

³⁶ See Bennett, *supra* note 18, at 148-49. This is the so-called "DNA print."

Id.

³⁷ See *id.* at 149.

there is no match, and the negative result is said to be conclusive.³⁸ If the location and distribution of the bands on the tracks are similar enough³⁹ to each other,⁴⁰ there is said to be a match, which means, at this point, only that the suspect is "not excluded."⁴¹ The next step is to determine the significance of the match.⁴²

2. *Polymerase Chain Reaction ("PCR")*

Another method of DNA identification is the Polymerase Chain Reaction ("PCR") procedure which is named after TAQ polymerase, the enzyme used in the process.⁴³ The technique utilizes a much smaller sample than RFLP and has less ability to maximize the significance of possible matches.⁴⁴ In this process, the sample of DNA to be used is again extracted, purified, and mixed with chemicals, including the TAQ polymerase enzyme. During successive cycles in a heating device, a specific "gene of interest" will be replicated billions of times.⁴⁵ Then the amplified DNA is flooded over a nylon membrane that is marked with specific probes, each of which is designed to recognize one variant of the "gene of interest," called an allele.⁴⁶ Wherever the probe recognizes a specific allele, a visible dot appears on the membrane.⁴⁷

To determine if two DNA samples have come from the same person, it is necessary to examine the results to see if they have produced the

³⁸ See *id.* (citing *United States v. Jakobetz*, 955 F.2d 786, 793 (2d Cir. 1992)).

³⁹ See *id.* (explaining that the "match does not have to be exact" for a match to be declared).

⁴⁰ *Jakobetz*, 955 F.2d at 793 (stating that the FBI will declare a match if the number of base pairs in the two bands differs less than 2.5%); *Fishback v. People*, 851 P.2d 884, 888 (Colo. 1993) (stating that one private laboratory requires that the length of two fragments be within one millimeter of each other to declare a match).

⁴¹ *Deftos*, *supra* note 28, at 962.

⁴² See *infra* notes 50-58 and accompanying text.

⁴³ See *Fleming*, *supra* note 18, at 322-23.

⁴⁴ See *Hoeffel*, *supra* note 22, at 474.

⁴⁵ See *Fleming*, *supra* note 18, at 323.

⁴⁶ An allele is "one of two or more alternative forms of a gene" that occupies the same locus on homologous chromosomes. NATIONAL RESEARCH COUNCIL, *supra* note 2, at 75, 167.

⁴⁷ See *Fleming*, *supra* note 18, at 323.

same pattern of dots.⁴⁸ If the results have not produced the same pattern of dots, there is no match between the two samples, so they could not have come from the same source.⁴⁹ If the dot patterns do match, another step must be performed, as with RFLP, to determine the significance of the match.

C. *The Use of Population Genetics and the Product Rule*

Despite the fact that the DNA profiling technique is referred to by some as "DNA fingerprinting," a match in a DNA test does not mean the same thing as a match of actual fingerprints. Typically, when a match of fingerprints is found, the result is regarded as an absolute. When a DNA match is found, it can only be stated that the person whose DNA is said to be a match with the crime scene sample can be included in the class of persons whose DNA could match.⁵⁰ It is still necessary to ascertain the size of that class for the significance of the match to be determined.

Since humans are more alike than different in our physical makeup (two arms, legs, hands, etc.), much of the DNA pattern will be identical from one person to another. However, it has been calculated that any two human genomes⁵¹ differ at approximately three million sites. Therefore, if enough of those three million sites could be compared, a unique identification would theoretically be possible. At the present time, however, only a very few of those sites — typically three to five — are examined and analyzed, and it is possible that two persons could have the same DNA pattern at those few sites.⁵² The question then becomes, what are the odds of such a random match? This is where population genetics and the product rule come into the picture.

Using a specific database with as few as 200 to 300⁵³ people to represent the entire population, the first step in the process is to determine the frequency of the occurrence in that database of the specific allele type

⁴⁸ See *id.*

⁴⁹ DNA exclusions are easy to interpret. If technical aspects are different between two samples, it is definitive proof that the samples did not come from the same source. See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 75.

⁵⁰ See *id.* at 112 (stating that "only when DNA technology is capable of sequencing the entire three billion base pairs of a person's genome could a DNA pattern be considered to be as constant and complete as a fingerprint pattern").

⁵¹ The genome is the entire set of heredity factors in an organism as contained in the chromosomes. See *id.* at 3, 169.

⁵² See *id.* at 74.

⁵³ See Hoeffel, *supra* note 21, at 489.

found at each of the loci (sites) used in the sample.⁵⁴ Thus, even if the database being used has only 500 people, the result of the second step (multiplying the possibility of identical alleles at different locus points) can result in a staggeringly low probability, such as one in a billion,⁵⁵ or even one in thirty billion.⁵⁶ It is this set of numbers that gives the DNA findings their teeth. When a random match is said to be one in thirty billion, or even thirty million, such a small possibility of an innocent explanation for the match between a sample taken from a suspect and a sample found at the crime scene can have a devastating effect on a jury.⁵⁷ The numbers usually generated by the PCR test are not nearly as high, which is one of the disadvantages of this test from the prosecution's viewpoint.⁵⁸

II. LEGAL CONSIDERATIONS FOR ADMISSIBILITY IN CRIMINAL CASES

A. *The Frye Hearing*

In evaluating the admissibility of scientific testimony in criminal cases, most courts, including those in Kentucky,⁵⁹ followed the standard set forth in *Frye v. United States*⁶⁰ until it was overruled⁶¹ in

⁵⁴ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 75-76.

⁵⁵ See *id.* at 76.

⁵⁶ See Hoeffel, *supra* note 22, at 488-89 (citing Alec J. Jeffreys et al., *Hypervariable 'Minsatellite' Regions in Human DNA*, 314 NATURE 67, 68 (1985)).

⁵⁷ See *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989). The frequency expressed was one in 33 billion, and the court refused to admit these numbers due to their potentially exaggerated impact on the jury. See *id.* at 424, 428-29.

⁵⁸ See George F. Sensabaugh & Cecilia Von Beroldingen, *The Polymerase Chain Reaction: Application to the Analysis of Biological Evidence*, in FORENSIC DNA TECHNOLOGY 63, 78 (Mark A. Farley & James J. Harrington eds., 1991).

⁵⁹ See *Harris v. Commonwealth*, 846 S.W.2d 678 (Ky. 1992), *overruled by Mitchell v. Commonwealth*, 908 S.W.2d 100 (Ky. 1995).

⁶⁰ *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923). This case involved testimony offered by a defense expert concerning the results of an early forerunner of a polygraph test, the "systolic blood pressure deception test."

⁶¹ Technically it was not overruled. The Supreme Court construed Federal Rule of Evidence 702 as superseding *Frye*, and thus *Frye* was dead. See *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 587 (1993); *infra* notes 70-91 and accompanying text.

1993.⁶² In rejecting the testimony offered, the *Frye* court stated that before scientific testimony could be introduced, "the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs."⁶³ The court concluded that the test offered had not yet gained such understanding and scientific recognition among physiological and psychological authorities as to justify its introduction.⁶⁴

Most jurisdictions, including Kentucky, conducted a "*Frye*" hearing before trial to determine if proffered scientific testimony had been generally accepted in the scientific community.⁶⁵ This was the standard applied when most of the DNA cases arose.⁶⁶ There has been virtually no dispute that the underlying technology of DNA profiling has been generally accepted in the scientific community.⁶⁷ Therefore, using the *Frye* test, most courts⁶⁸ that have considered the issue have concluded that DNA profiling procedures and results are admissible.⁶⁹

B. *The Daubert Hearing*

*Daubert v. Merrell Dow Pharmaceuticals, Inc.*⁷⁰ did not involve or discuss the admissibility of DNA but simply the admissibility of expert scientific evidence in general. The Court determined that *Frye* was no longer relevant with the passage of Federal Rule of Evidence ("FRE") 702, which deals with the admissibility of scientific evidence in federal

⁶² *Id.*

⁶³ *Frye*, 293 F. at 1014.

⁶⁴ *See id.*

⁶⁵ *See supra* notes 61-64 and accompanying text.

⁶⁶ Apparently, this standard was construed as being more rigid than Federal Rule 702. In *Daubert*, the United States Supreme Court reversed the lower courts' decisions disallowing certain expert testimony on the ground that such evidence did not satisfy the standard set forth in *Frye*. *See Daubert*, 509 U.S. at 579.

⁶⁷ *See* Barry C. Scheck, *DNA and Daubert, Scientific Evidence After the Death of Frye, Criminal Forensics and DNA Evidence*, 15 CARDOZO L. REV 1959, 1962 (1994) (citing NATIONAL RESEARCH COUNCIL, *supra* note 2).

⁶⁸ *See infra* notes 242-58 and accompanying text, discussing cases disallowing the introduction of DNA evidence on bases other than the *Frye* standard.

⁶⁹ *But see infra* notes 102-80.

⁷⁰ *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993).

courts, and discussed the new standards to be applied.⁷¹ FRE 702 provides:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.⁷²

The Court stated that "[n]othing in the text of this Rule establishes 'general acceptance' as an absolute prerequisite to admissibility,"⁷³ and that adopting a "rigid 'general acceptance' requirement"⁷⁴ would be contrary to the "liberal thrust"⁷⁵ of the Federal Rules and their "general approach of relaxing the traditional barriers to 'opinion testimony'."⁷⁶ The Court proceeded to provide some "general observations"⁷⁷ to help the trial judge assess the admissibility of disputed scientific evidence by evaluating whether the "reasoning or methodology underlying the testimony is scientifically valid and whether that reasoning or methodology properly can be applied to the facts in issue."⁷⁸ A key question for the trial judge is whether the scientific theory or technique can be or has been tested.⁷⁹

⁷¹ See *id.* at 587.

⁷² FED. R. EVID. 702. Kentucky adopted an identical rule that became effective in July 1992. See KY. R. EVID. 702. See *Mitchell v. Commonwealth*, 908 S.W.2d 100 (Ky. 1995) (upholding the admission of DNA evidence against a defendant).

⁷³ *Daubert*, 509 U.S. at 588.

⁷⁴ *Id.* The Court called the general acceptance test "uncompromising." *Id.*

⁷⁵ *Id.*

⁷⁶ *Id.* (citing *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169 (1988)).

⁷⁷ *Id.* at 593. In a concurring-in-part, dissenting-in-part opinion, Chief Justice Rehnquist, joined by Justice Stevens, criticized the majority for these "observations," calling them unnecessary, too general, vague, and abstract. See *id.* at 598.

⁷⁸ *Id.* at 592-93.

⁷⁹ The Court stated: "Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified." *Id.* (quoting Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation: The Legacy of Agent Orange and Bendectin Litigation*, 86 N.W. L. REV. 643, 645 (1992)). Chief Justice Rehnquist, in his concurring/dissenting opinion, said, "I am at a loss to know what is meant when it is said that the scientific status of a theory depends on its 'falsifiability,' and I suspect

Other general considerations discussed by the Court include whether the theory or technique has been subjected to peer review and publication,⁸⁰ the rate of error of a particular scientific technique,⁸¹ and the general acceptance standard inherited from *Frye*.⁸² The Court referred to its new standard as a flexible inquiry to determine scientific validity of the proffered testimony with a focus solely on principles and methodology.⁸³ The Court also pointed out that FRE 403, which permits a court to exclude evidence if its probative value is substantially outweighed by the danger of unfair prejudice, is an added safeguard.⁸⁴

In a further discussion of the topic of relevance under FRE 702, *Daubert* referred to a requirement called "fit."⁸⁵ The Court explained this issue as simply "whether expert testimony proffered in the case is sufficiently tied to the facts of the case that it will aid the jury in resolving a factual dispute."⁸⁶ The problem is that "scientific validity for one purpose is not necessarily scientific validity for other, unrelated purposes,"⁸⁷ and the entire forensic DNA process was adapted from

some [federal judges] will be, too." *Id.* at 600.

Falsifiability of a scientific premise simply refers to whether there is any evidence that can be offered or there are tests that can be performed, even in principle, to prove the theory is false. If not, the validity of the theory cannot be confirmed either.

[W]hat characterizes the empirical method is its manner of exposing to falsification, in every conceivable way, the system to be tested. Its aim is not to save the lives of untenable systems but, on the contrary, to select the one which is by comparison the fittest, by exposing them all to the fiercest struggle for survival.

KARL POPPER, *THE LOGIC OF SCIENTIFIC DISCOVERY* 42 (1959).

⁸⁰ See *Daubert*, 509 U.S. at 593.

⁸¹ See *id.* at 594 (citing *United States v. Smith*, 869 F.2d 348 (7th Cir. 1989)).

⁸² See *id.* The Court said that a "reliability assessment does not require, although it does permit, explicit identification of a relevant scientific community and an express determination of a particular degree of acceptance within that community." *Id.* (citing *United States v. Downing*, 753 F.2d 1224, 1238 (3d Cir. 1985)).

⁸³ See *id.* at 594-95.

⁸⁴ See *id.* at 595.

⁸⁵ *Id.* at 591.

⁸⁶ *Id.*

⁸⁷ *Id.*, see *infra* notes 102-35 and accompanying text for a discussion of the importance of DNA "fit" issues.

the medical diagnostic DNA process, which has a totally different purpose.

It may be premature to determine if *Daubert* will have any impact on DNA issues. With courts generally allowing DNA testimony in criminal cases under the "general acceptance" test of *Frye*, described by the *Daubert* Court as being "rigid"⁸⁸ and "uncompromising,"⁸⁹ certainly the more "flexible"⁹⁰ test of *Daubert* under FRE 702, designed for "relaxing the traditional barriers to 'opinion' testimony,"⁹¹ would not appear to create major roadblocks. However, the Supreme Court has yet to enter the playing field to discuss the "fit" portion of *Daubert* and its application to DNA.

C. Admissibility by Statute

Many states have enacted statutes⁹² to cover the admissibility of DNA evidence in civil and/or criminal cases.⁹³ Some of them deal with admissibility in paternity and other civil matters only and say nothing of criminal proceedings.⁹⁴ Some states have established data

⁸⁸ *Daubert*, 509 U.S. at 588.

⁸⁹ *Id.* at 596.

⁹⁰ *Id.* at 594.

⁹¹ *Id.* at 588 (quoting *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169 (1988)).

⁹² Such statutes could run into difficulty with courts based upon the separation of powers doctrine because they usurp the judicial function of determining court rules. In Kentucky, for example, when the legislature passed the so-called Truth in Sentencing statute (KY. REV. STAT. ANN. § 532.055 (Banks-Baldwin 1974)), the Kentucky Supreme Court held in *Reneer v. Commonwealth*, 734 S.W.2d 794 (Ky. 1987), that the statute was a violation of the separation of powers doctrine, but the court upheld the statute based on the principle of "comity."

⁹³ See ALA. CODE § 36-18-20, -24, -30 (1996); ALASKA STAT. §§ 09.25.051, 12.45.035 (Michie 1996); CONN. GEN. STAT. §§ 46b-168, 54-86k (1997); DEL. CODE ANN. tit. 11, § 3515 (1996); ILL. COMP. STAT. ANN. §§ 5/103-5, 45/11 (West 1996); IND. CODE ANN. § 35-37-4-13 (West 1997); LA. CIV. CODE ANN. art. 187 (West 1997); LA. REV. STAT. ANN. §§ 15:441.1, 9:397.3 (West 1996); MD. CODE ANN. CTS. & JUD. PROC. § 10-915 (1996); MINN. STAT. ANN. §§ 634.25-26 (West 1996); N.D. CENT. CODE § 31-13-02 (West 1997); OKLA. STAT. ANN. tit. 22, § 751.1 (West 1996); TENN. CODE ANN. § 24-7-112, -117 (1996); VA. CODE ANN. § 19.2-270.5 (Michie 1997).

⁹⁴ See ARK. CODE ANN. § 9-27-342 (Michie 1995); GA. CODE ANN. § 19-7-46 (1997); MICH. COMP. LAWS ANN. § 722.716 (West 1996); N.M. STAT. ANN.

banks⁹⁵ to obtain and store DNA records of certain people, often persons convicted of specific felonies or of crimes against persons,⁹⁶ in order to help identify a repeat offender through DNA comparisons. Some of the state statutes dealing with DNA specifically provide for the admissibility of such evidence in criminal cases without expert testimony establishing the reliability of the evidence.⁹⁷

On the other hand, Alabama's statute allows DNA evidence only by way of expert testimony if the trial court determines the testimony meets the requirements of *Daubert*.⁹⁸ Alaska's statute does not mention *Daubert* but provides that in a criminal proceeding "evidence of a DNA profile is admissible if the court finds that the technique underlying the evidence is scientifically valid."⁹⁹

§ 40-11-13 (Michie 1997); N.Y. FAM. CT. ACT §§ 418, 532 (McKinney 1997); OHIO REV. CODE ANN. § 3111.09, .12 (Banks-Baldwin 1997).

⁹⁵ See ALA. CODE § 36-18-20, -24 (1996); ALASKA STAT. § 44.41.035 (Michie 1996); CONN. GEN. STAT. § 54-102g (1997); DEL. CODE ANN. tit. 29, § 4713 (1996); GA. CODE ANN. § 24-4-60 (1997); IND. CODE ANN. § 10-1-9-8 (West 1997); ME. REV. STAT. ANN. tit. 25, § 1577 (West 1996); MD. CODE ANN. OF 1957 art. 88B, § 12A (1996); MINN. STAT. ANN. § 299C.155 (West 1996); MO. ANN. STAT. § 650.050 (West 1996); MONT. CODE ANN. § 44-6-102 (1996); N.C. GEN. STAT. § 15A-266.1 (1996); TEX. GOV'T CODE ANN. § 411.143, .144, .146 (West 1995); VA. CODE ANN. § 19.2-310.4 (Michie 1997); WASH. CODE REV. ANN. § 43.43.756, .758 (West 1996); W. VA. CODE § 15-2B-8 (1997).

⁹⁶ For instance, Alabama's statute specifically states that many types of crimes are committed by repeat offenders and therefore establishes a DNA data bank of persons convicted of felonies and attempts to commit felonies. See ALA. CODE § 36-18-20 (1996).

⁹⁷ For example, Tennessee provides:

In any civil or criminal trial, hearing or proceeding, the results of DNA analysis are admissible in evidence without antecedent expert testimony that DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual's genetic material upon a showing that the offered testimony meets the standards of admissibility set forth in the Tennessee Rules of Evidence.

TENN. CODE ANN. § 24-7-117(b)(1) (1996); see also IND. CODE ANN. § 35-37-4-13 (West 1997).

⁹⁸ See ALA. CODE § 36-18-30 (1996).

⁹⁹ ALASKA STAT. § 12.45.035(a) (Michie 1996). The statute specifically states that it is not necessary to prove that the DNA evidence has general acceptance in the relevant scientific community. See *id.*

Most statutes do not specifically mention population genetics in connection with DNA evidence, but Minnesota's law includes one that does:

In a civil or criminal trial or hearing, statistical population frequency evidence, based on genetic or blood test results, is admissible to demonstrate the fraction of the population that would have the same combination of genetic markers as was found in a specific human biological specimen. "Genetic marker" means the various blood types or DNA types that an individual may possess.¹⁰⁰

Interestingly, the Minnesota Supreme Court rejected such testimony in a case decided after the statute was enacted, although the statute was not in effect until after the trial and thus was specifically not considered in the appeal.¹⁰¹

III. TECHNICAL PROBLEMS FOR ADMISSIBILITY UNDER *Frye* AND *Daubert*

A. *Problems Concerning the Technology*

The scientific principles involved in comparison of DNA profiles are not a problem either in the scientific community or in the courts.¹⁰² It is not generally questioned that the underlying theories and even the techniques used in DNA testing are valid.¹⁰³ The potential problems lie elsewhere.

When appellate courts first considered the admissibility of DNA evidence under *Frye*, the issue was discussed in terms of "general acceptance" in the scientific community.¹⁰⁴ Of course, DNA profiling through RFLP analysis was accepted by scientists. It had been used for years in research.¹⁰⁵ However, to say that the procedure used for

¹⁰⁰ MINN. STAT. § 634.26 (1996).

¹⁰¹ See *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989) (holding that DNA testing is admissible under *Frye*, but must be available for independent review by opposing counsel); discussion *infra* notes 251-58 and accompanying text.

¹⁰² See Scheck, *supra* note 67.

¹⁰³ See Richard Lempert, *The Suspect Population and DNA Identification*, 34 JURIMETRICS J. 1, 2 (1993).

¹⁰⁴ See, e.g., *Andrews v. State*, 533 So.2d 841 (Fla. Dist. Ct. App. 1988) (discussing the "general acceptance" test at length but ultimately applying a "relevancy/reliability" test instead).

¹⁰⁵ See Hoeftel, *supra* note 22, at 475-76.

medical diagnosis was accepted by the scientific community is not the same as saying that the use of DNA in forensics is "generally accepted." The techniques in the two areas are very different, with many potential problems in forensics that are not present in medical diagnosis.¹⁰⁶

One obvious, but crucial, difference is that in medicine the samples of DNA are "clean," with no contamination, and are taken from known sources. Any questionable or ambiguous results can be repeated for verification.¹⁰⁷ The process involves discrete alternatives¹⁰⁸ and has a built-in consistency check against artifacts.¹⁰⁹ It never requires the use of population genetics or statistical probabilities. In short, diagnostic DNA is not used to identify a source.¹¹⁰ On the other hand, the forensic use of DNA often involves contaminated or degraded samples, possibly from multiple unknown sources. When the sample from a crime scene is limited, as it generally is, the test cannot be repeated. Any possible match then involves the questionable use of statistical analysis of population genetics to give it significance.¹¹¹

Mere acceptance of a procedure by research scientists may not be the best index of whether it should be accepted for identification purposes in criminal prosecutions.¹¹² The probability is very high that the sample obtained from a crime scene is contaminated with bacteria, which contains DNA like every other species. The probe could bind with DNA

¹⁰⁶ Research-oriented DNA analysis typically involves comparisons of the DNA between family members to detect possible inheritance of disease-causing genes or comparisons with known standards to detect mutations. See Scheck, *supra* note 67, at 1964.

¹⁰⁷ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 52.

¹⁰⁸ For instance, the question might ask which of two alleles a child inherited from a parent. See *id.*

¹⁰⁹ Artifacts can occur in any laboratory and can lead to an incorrect interpretation if not recognized. See *id.* at 52, 54.

¹¹⁰ See Hoeffel, *supra* note 22, at 478.

¹¹¹ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 52-53.

¹¹² Research scientists can deal with high rates of error and unreliability in their procedures. When something interesting is found in an experiment, the procedure can be repeated many times to assure its accuracy. Errors will stand out in research procedures because the findings are inconsistent with scientific knowledge and theory. In a forensic laboratory, the situation is completely different since tests cannot be repeated, and the only time an error may "stand out" is when it is inconsistent with the prosecutor's case. See William C. Thompson & Simon Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Tests*, 75 VA. L. REV. 45, 56-57 (1989).

from the bacteria and produce a misleading result.¹¹³ Part of the problem in *People v. Castro*,¹¹⁴ the first case to reject the use of DNA evidence in a criminal trial, involved the use of probes known to be contaminated with bacteria. Lifecodes, the private company that conducted the DNA testing, ignored the contaminated probes and declared the sample to be a match with the defendant's DNA. In order to get a match between the samples of blood taken from the defendant's watch and the victim of a murder, Lifecodes chose to ignore two extra bands on the autoradiograph from the watch stain.¹¹⁵

An examination of the problems in *Castro* should bring pause to any court considering the introduction of DNA evidence, because the case involved a hearing on admissibility in which experts testified for twelve weeks. Initially, Lifecodes declared a match, which led to the criminal charge. After twelve weeks of expert testimony, some of the Lifecodes experts changed their minds and recanted their match-call testimony.¹¹⁶ What if *Castro* had not been represented by Barry Scheck and Peter Neufeld? What if the defense had not attacked the DNA evidence with experts of its own, as has been the situation in many trials? The defense in *Castro* was able to find many blunders made by Lifecodes in its procedures that changed the complexion of that case and undoubtedly influenced the entire recent history of forensic DNA.¹¹⁷ How many blunders have gone undetected when the defense did not have the resources for such an all-out assault on the laboratory?

A process that is so incredibly complex has many facets that can give rise to problems. Many lawyers and judges¹¹⁸ do not have the knowledge to deal with these issues, or the time to study to become knowledgeable.¹¹⁹ One aspect of the laboratory environment that can lead to erroneous interpretation is referred to in the literature as laboratory "slop"¹²⁰ brought about by the "inevitable variability and imperfection

¹¹³ See Hoeffel, *supra* note 22, at 480, 482.

¹¹⁴ *People v. Castro*, 545 N.Y.S.2d 985 (Sup. Ct. 1989). This case is discussed at length in Hoeffel, *supra* note 22, at 477-78.

¹¹⁵ See Hoeffel, *supra* note 22, at 480.

¹¹⁶ See *id.* at 478.

¹¹⁷ See *id.*

¹¹⁸ See *supra* note 79. In fact, Chief Justice Rehnquist admitted that not even he understood the meaning of falsifiability. In light of this admission, how will he deal with the entire DNA issue?

¹¹⁹ Not every criminal defendant can afford to hire a separate DNA lawyer to supplement his regular trial attorney, as O.J. Simpson did.

¹²⁰ See Hoeffel, *supra* note 22, at 481.

of testing conditions.”¹²¹ For example, the DNA patterns may be difficult to read for a variety of reasons, such as variations in the thickness and consistency of the gels used in the electrophoresis stage or variations in the temperature and voltage level used in the process.¹²²

There are many possible errors at every step of the process. For instance, in the Southern blot procedure, bubbles on the nylon membrane may prevent the transference of some DNA bands and cause them to disappear.¹²³ Some faint bands of DNA may be very difficult to see and thus cause the interpretations to vary.¹²⁴ There is also disagreement on the significance of “band shifting” and how to deal with it.¹²⁵ In addition to these major hurdles, an overall problem is that there are no “uniform standards and quality controls”¹²⁶ to ensure common procedures and accurate interpretations of results. There are recommendations, but no requirements. Some laboratories have adopted the guidelines published by TWGDAM,¹²⁷ a group coordinated by the FBI.¹²⁸

With all of the complexities of the DNA profiling process, some experts believe that the most common error in the process is human error.¹²⁹ The National Research Council asserted that laboratory errors will happen in the best laboratories, “even when the analyst is certain that every precaution” has been taken to prevent error.¹³⁰ The Council

¹²¹ See *id.*

¹²² See *id.*, Thompson & Ford, *supra* note 112, at 87 n.188.

¹²³ See Thompson & Ford, *supra* note 112, at 91 n.200.

¹²⁴ In *People v. Castro*, 545 N.Y.S.2d 985 (Sup. Ct. 1989), experts disagreed on how many bands they could see. See Hoeffel, *supra* note 22, at 481.

¹²⁵ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 61, see also *People v. Keene*, 591 N.Y.S.2d 733 (Sup. Ct. 1992) (holding DNA evidence inadmissible when it was impossible to conclude whether method used by laboratory was generally accepted); *infra* notes 250-51 and accompanying text.

¹²⁶ Hoeffel, *supra* note 22, at 479 (citing Eric Lander, *DNA Fingerprinting on Trial*, 339 NATURE 501 (1989)).

¹²⁷ Technical Working Group on DNA Analysis Methods.

¹²⁸ See *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989) (explaining the nature and work of TWGDAM).

¹²⁹ See Bennett, *supra* note 18, at 154 (citing Lawrence B. Ebert, Comment, Frye after Daubert: *The Role of Scientists in Admissibility Issues As Seen Through Analysis of the DNA Profiling Cases*, 1993 U. CHI. L. SCH. ROUNDTABLE 219, 243).

¹³⁰ NATIONAL RESEARCH COUNCIL, *supra* note 2, at 89.

pointed out that early in the DNA approach there were high rates of false positives due to laboratory error.¹³¹

With the new criteria for the admissibility of expert testimony set forth in *Daubert*,¹³² some issues that did not arise under the *Frye* question of general acceptance could surface.¹³³ For instance, the "fit" requirement¹³⁴ could lead to some interesting discussions, since the issue of DNA admissibility deals with whether the undoubtedly valid and reliable technique used in medicine and diagnostic laboratories can be transferred to forensics and be equally valid and reliable.¹³⁵

B. Problems With Population Genetics and the Product Rule

Problems in getting DNA evidence before a jury often involve population genetics and the product rule.¹³⁶ There is considerable controversy about the method of obtaining a statistical correlation between the sample and the population as a whole.¹³⁷ As stated previously, the statistical significance of a match is determined in a two-step process.¹³⁸ First, the probability of each matching band being present in a sample by random chance is ascertained using a database of DNA profiles. Second, the probability of all matching bands being present by random chance is calculated by multiplying the frequencies of each separate band.¹³⁹ For instance, if the odds of the first band being located in a random sample are five in one hundred and the odds of the second band are seven in one hundred, the overall odds of both being found in the same sample, thirty-five in ten thousand, are determined by multiplying those two figures. When this number is multiplied two or three more times, the odds against a random match become very high.

¹³¹ See *id.* at 88-89.

¹³² *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993).

¹³³ See *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923), discussed *supra* notes 59-69 and accompanying text.

¹³⁴ This requires "proof that a scientific technique is valid for the purpose to which it is being applied." *Scheck, supra* note 67, at 1962.

¹³⁵ For a thorough discussion of some of the technical pitfalls in the process of DNA profiling that are beyond the scope of this Note, see *Hoeffel, supra* note 22, and *Scheck, supra* note 67, and the many references therein.

¹³⁶ See, e.g., *State v. Bible*, 858 P.2d 1152 (Ariz. 1993).

¹³⁷ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 74-75.

¹³⁸ See *supra* notes 50-58 and accompanying text.

¹³⁹ See *Scheck, supra* note 67, at 1970-71.

One problem with this process is the size of the database. There is no consensus for how large a database must be to accurately represent the entire population. One estimate states the probability that two persons might by chance have the same DNA profile as one in thirty billion. This was based on a study of fourteen British Caucasians.¹⁴⁰ Studies published by Lifecodes, the testing laboratory in *Castro*,¹⁴¹ consisted of the DNA profiles of between 200 and 300 people taken from blood banks in the New York area.¹⁴²

Another problem arises from two major assumptions that provide the entire basis for this statistical evidence.¹⁴³ The first necessary assumption is that the population database used for comparison is in Hardy-Weinberg equilibrium.¹⁴⁴ This requires that there be no correlation between the two alleles, one from the mother and one from the father, found at the same locus.¹⁴⁵ In other words, the mating process must be completely random.¹⁴⁶ The other assumption underlying the validity of the product rule is that the bands produced by each probe are independent of the bands produced by the other probes.¹⁴⁷ In technical terms, the assumption is that they are in "linkage equilibrium."¹⁴⁸

One of the major problems with these assumptions is that they discount the possibility of the existence of subgroups within the

¹⁴⁰ See Hoeffel, *supra* note 22, at 488-89 (citing Jeffreys et al., *supra* note 56, at 68).

¹⁴¹ *People v. Castro*, 545 N.Y.S.2d 985 (Sup. Ct. 1989).

¹⁴² See Thompson & Ford, *supra* note 112, at 84 n.177.

¹⁴³ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 5.

¹⁴⁴ "Hardy-Weinbergequilibrium depends on a truly random population with a thoroughly mixed gene-pool." Bennett, *supra* note 18, at 151.

¹⁴⁵ See *id.* (citing Sherry J. Whitney, Note, *State v. Bible: The Admissibility of Forensic DNA Profiling and Statistical Probability Evidence in Arizona Criminal Proceedings*, 26 ARIZ. ST. L.J. 593, 600 (1994)); *infra* notes 255-58 and accompanying text (discussing *State v. Bible*, 858 P.2d 1152 (Ariz. 1993), which held that evidence should have been excluded because statistical methods were not accepted by scientific community).

¹⁴⁶ The term "random mating" refers to the assumption that alleles will not have some influence on mate selection. See Thompson & Ford, *supra* note 112, at 85.

¹⁴⁷ See *id.*

¹⁴⁸ See R.C. Lewontin & Daniel L. Hartl, *Population Genetics in Forensic DNA Typing*, 254 SCIENCE 1745, 1747-49 (1991).

population where there are distinct allele frequencies.¹⁴⁹ Such subgroups may occur in a given population when the mating is not entirely random,¹⁵⁰ and these subgroups may have allele frequencies very different from the population as a whole.¹⁵¹ Databases generally are divided into classes based on race, such as Caucasian, black, and Hispanic, and ignore evidence of genetic substructures within these broad categories.¹⁵² They also ignore the fact that such groups do not mate completely randomly.¹⁵³ If there is a population substructure within the broad racial group¹⁵⁴ of the database, it is not valid to assume independence of the alleles, and therefore the product rule is not valid.¹⁵⁵

How the product rule can create a small but misleading percentage is demonstrated by calculating the percentage of fair-skinned, blond, blue-eyed people in Europe. First, if a survey showed that one in ten people were blond, one in ten people had blue eyes, and one in ten people had fair skin, the product rule would multiply .1 by .1 by .1 to determine the frequency of all three characteristics appearing in one person: 1 in 1000. Yet that figure would be very misleading because it ignores the fact that such traits tend to occur together in Nordic people, and the actual probability of persons having all three traits would be much higher than the 1 in 1000 obtained by the product rule.¹⁵⁶ Clearly, some alleles are not independent of each other despite procedural assumptions.¹⁵⁷

Since there is not a counterpart in the diagnostic use of DNA profiling to the population genetics and product rule required for it to be used in forensics, it has been more difficult for prosecutors to show general scientific acceptance of this procedure under the *Frye* rule.¹⁵⁸

¹⁴⁹ See *id.*

¹⁵⁰ See Elizabeth A. Allen, Note, *The Admissibility of DNA Evidence in Washington After State v. Cauthron*, 69 WASH. L. REV. 383, 388 (1994).

¹⁵¹ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 48.

¹⁵² See Lewontin & Hartl, *supra* note 148, at 1746.

¹⁵³ See *id.*

¹⁵⁴ This would be a subgroup whose allele frequencies would differ significantly from the loci used by the laboratories.

¹⁵⁵ See Scheck, *supra* note 67, at 1971.

¹⁵⁶ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 76.

¹⁵⁷ The FBI has begun to reassess the assumptions. While generally using databases consisting of either Caucasians, blacks, or Hispanics, the FBI plans in the future to use databases obtained from nearby regions rather than the national race-based pools of the population at large. See Christopher Anderson, *FBI Gives in on Genetics*, 355 NATURE 663, 663 (Feb. 1992).

¹⁵⁸ See, e.g., *State v. Bible*, 858 P.2d 1152 (Ariz. 1993) (discussed *infra* notes

Due in part to the controversy generated by these problems, some courts have refused to allow DNA evidence.¹⁵⁹

C. *Recommendations of the National Research Council*

1. *1992 Recommendations*

Because of the rising tide of questions about DNA typing in the aftermath of many well-publicized criminal cases, calls were made for an in-depth study of the problems, as well as recommendations, relating to DNA testing.¹⁶⁰ The first study by the National Research Council ("NRC") was concluded and published in 1992.¹⁶¹ The reaction to the report and its recommendations was mixed. The FBI protested that it was pro-defendant,¹⁶² while some population geneticists claimed it favored the prosecution.¹⁶³ Some courts have reversed convictions based upon the report¹⁶⁴ and have cited it as evidence of a lack of general acceptance of the statistical methods of interpreting data.¹⁶⁵

Noting the lack of disagreement concerning the underlying principles of DNA typing, the NRC emphasized that there still could be a question of whether a particular typing method is "scientifically appropriate"¹⁶⁶ for forensic use. The Council reported that "too many methods exist or are planned, and too many issues must be addressed in detail"¹⁶⁷ for the report to provide technical descriptions of DNA typing. The report even made a disparaging comment about legislation that authorizes the admission of DNA results into evidence,¹⁶⁸ calling such statutes "vague-

255-58 and accompanying text).

¹⁵⁹ See *infra* notes 251-58 and accompanying text.

¹⁶⁰ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at vii.

¹⁶¹ See Kenneth R. Kreiling, *DNA Technology in Forensic Science*, 33 JURIMETRICS J. 449, 459 (1993).

¹⁶² See Deftos, *supra* note 28, at 964.

¹⁶³ See Kreiling, *supra* note 161, at 458-59.

¹⁶⁴ See, e.g., *Commonwealth v. Curnin*, 565 N.E.2d 440 (Mass. 1991). See *infra* notes 251-58 and accompanying text for discussion.

¹⁶⁵ See, e.g., *People v. Wallace*, 17 Cal. Rptr. 2d 721, 725 (Ct. App. 1993); *People v. Barney*, 10 Cal. Rptr. 2d 731, 739 (Ct. App. 1992), *abrogated by* *People v. Wilds*, 37 Cal. Rptr. 2d 351 (Ct. App.), *review granted* 39 Cal. Rptr. 2d 406 (1995).

¹⁶⁶ The report stated that it is "meaningless" to speak of the reliability of DNA profiling in general without specific reference to a particular method. NATIONAL RESEARCH COUNCIL, *supra* note 2, at 52.

¹⁶⁷ *Id.*

¹⁶⁸ See *supra* notes 92-101 and accompanying text.

ly worded" and suggesting that they be limited to the only method in general use at the time.¹⁶⁹

One of the procedures recommended by the NRC to help authenticate a match result is the practice of sample splitting¹⁷⁰ suggested by critics of forensic laboratories.¹⁷¹ "The idea is to split the DNA sample being examined and have it tested independently by two or more different laboratories using different DNA loci and different 'match' criteria."¹⁷² This procedure, one of the few ways in which a DNA match can be tested, is significant given *Daubert's* admissibility standards, which include "testability" as a factor.¹⁷³

One of the most important recommendations made by the NRC regarding the procedures used for DNA typing was that an accreditation program be established requiring all laboratories conducting DNA testing to be accredited and to follow standard protocols. A failure to obtain accreditation after a suitable period of time would render test results inadmissible in court. The most controversial recommendation of the NRC suggests the use of a modification of the product rule, the statistical method generally used to calculate the frequency of a possible random match. The NRC called its modification the "ceiling principle."¹⁷⁴ The ceiling principle is designed to obtain a much more conservative frequency figure. The method involves taking random samples from fifteen or twenty different genetically homogeneous groups and determining the allele frequency at certain loci. Then, when applying the product rule, the laboratory would use either the actual frequency of the alleles as found in the subgroups, or five percent, whichever is higher.¹⁷⁵ This

¹⁶⁹ This would be the "conventional RFLP analysis of single-locus probes on Southern blots." The report said, "We trust that courts will recognize the limitations inherent in such statutes." NATIONAL RESEARCH COUNCIL, *supra* note 2, at 52.

¹⁷⁰ *See id.* at 67

¹⁷¹ *See generally* Richard Lempert, *Some Caveats Concerning DNA as Criminal Identification Evidence: With Thanks to the Reverend Bayes*, 13 CARDOZO L. REV. 303 (1991).

¹⁷² Scheck, *supra* note 67, at 1969.

¹⁷³ *See id.*

¹⁷⁴ *See* NATIONAL RESEARCH COUNCIL, *supra* note 2, at 82. There are several technical recommendations made by the NRC that are beyond the scope of this Note. *See id.* at 72-73.

¹⁷⁵ The purpose of sampling various populations is to examine whether some alleles have considerably higher frequencies in particular subgroups than in the general population — presumably because of

approach to calculating population frequencies has been criticized both as “extremely conservative”¹⁷⁶ and as not conservative enough.¹⁷⁷ In response to the criticism and the promise of the FBI to fund another study, the NRC agreed to reconsider this recommendation.¹⁷⁸

2. 1996 Recommendations

After further studies, the NRC published another book that modified the original recommendations. An early report on the findings released in May 1996 revealed the NRC’s new position: Since sufficient data has been obtained for various subgroups, it is no longer necessary to utilize the “ceiling principle” previously recommended.¹⁷⁹ The NRC continues to recommend accreditation for laboratories conducting DNA profiling and various processes to assure quality control. These include the

genetic drift. It is matches at such alleles that might be accorded too much evidentiary weight, if the general population frequency were used in calculating the probability of a match.

Id. at 83-84.

¹⁷⁶ B. Devlin et al., *Statistical Evaluation of DNA Fingerprinting: A Critique of the NRC’s Report*, 259 SCIENCE 748, 837 (1993).

¹⁷⁷ See Jennifer R. Slimowitz & Joel E. Cohen, *Violations of the Ceiling Principle: Exact Conditions and Statistical Evidence*, 53 AM. J. HUM. GENETICS 314 (1993).

¹⁷⁸ See Scheck, *supra* note 67, at 1972; see also *infra* notes 219-24 and accompanying text.

¹⁷⁹ See *Bureau of National Affairs, Inc.*, 10 CRIMINAL PRACTICE MANUAL 202 (May 22, 1996). In proposing the elimination of the ceiling principles recommended in the 1992 book, the new National Research Council book suggested that any error in the frequencies based upon the now conceded effects of subpopulations would be less than ten fold in either direction of the result reached from the general product rule. Thus, in place of any ceiling principle it recommended that the frequencies of a random match be estimated to be within a factor of ten of the actual number obtained from the product rule. See NATIONAL RESEARCH COUNCIL, *THE EVALUATION OF FORENSIC DNA EVIDENCE* 156-58 (1996). The new book suggested that with probabilities of one in 100 million or less, an error of ten fold either way would not effect the result. *Id.* at 151. This book further pointed out that the Kentucky State Police Forensic Crime Laboratory uses the population of the United States as a cut off point, simply saying that the probability of a random match is less than one in whatever the population is, rather than an actual lower number such as one in a billion. This method is currently not recommended by the National Research Council. See *id.* at 136.

confirmatory testing of split samples, preferably by a separate laboratory, to avoid match errors. The NRC also recommends that laboratories adopt and adhere to standards such as those developed by TWGDAM and urges further research into the use of marker systems, with respect to quantity and quality, with a goal of making each DNA profile unique (except for identical twins).¹⁸⁰

IV ADMISSIBILITY IN KENTUCKY AND SELECTED OTHER STATES

A. *Treatment of DNA in Kentucky*

Kentucky has no statute specifically referring to the admissibility of DNA evidence, so this decision is left to the discretion of the trial court. There are only two reported cases that have ruled on the admissibility of DNA evidence. In *Harris v. Commonwealth*¹⁸¹ and *Mitchell v. Commonwealth*¹⁸² the Supreme Court of Kentucky held that the trial judge did not abuse his or her discretion in permitting the introduction of DNA evidence.¹⁸³ The first case, *Harris*, was decided under the *Frye* general acceptability regime.¹⁸⁴ The second case, *Mitchell*, was decided after *Daubert*¹⁸⁵ and therefore simply adopted the test set forth in *Daubert*.¹⁸⁶ Since Kentucky's rule on expert testimony, Kentucky Rule of Evidence 702, is a duplication of FRE 702, on the basis of which *Daubert* was decided,¹⁸⁷ the court simply reiterated the general requirements discussed in *Daubert* and concluded that the trial court had not abused its discretion.

The critical aspect of Kentucky's case law thus far has been the court's refusal to state categorically that DNA evidence is per se admissible. Both decisions limited their holdings to the facts involved,

¹⁸⁰ See *Bureau of National Affairs, Inc.*, *supra* note 179, at 203-04.

¹⁸¹ *Harris v. Commonwealth*, 846 S.W.2d 678 (Ky. 1992), *overruled by Mitchell v. Commonwealth*, 908 S.W.2d 100 (Ky. 1995).

¹⁸² *Mitchell v. Commonwealth*, 908 S.W.2d 100 (Ky. 1995), *overruling Harris v. Commonwealth*, 846 S.W.2d 678 (Ky. (1992)).

¹⁸³ See *Harris*, 846 S.W.2d at 678; *Mitchell*, 908 S.W.2d at 100.

¹⁸⁴ See *supra* notes 59-69 and accompanying text.

¹⁸⁵ See *supra* notes 70-91 and accompanying text.

¹⁸⁶ *Mitchell* overruled *Harris* insofar as the standard used in the latter was said to be *Frye*.

¹⁸⁷ KY. R. EVID. 702 became effective in July 1992 after the trial in *Harris*. See *Mitchell*, 908 S.W.2d at 101.

with the simple ruling that the trial court did not abuse its discretion. The Supreme Court of Kentucky has left open the general issue of DNA admissibility until the proper case comes along, specifically one where a hearing is held with experts called by both sides or by the trial court¹⁸⁸ to supplement or rebut the prosecution's case.¹⁸⁹

The evidence in *Harris* concerning DNA was that "the DNA profile of the semen found on the [rape] victim matched the DNA profile of the blood given by Harris."¹⁹⁰ A special agent from an FBI laboratory testified at trial that all four probes matched, and "the 'likelihood of finding another unrelated individual from the black population, having a DNA profile like Mr. Harris, is approximately one in eight million.'"¹⁹¹

A pretrial motion had been filed in the case to preclude the introduction of DNA evidence. A pre-trial hearing¹⁹² was held in which the Commonwealth called two experts to testify, and the defense called none.¹⁹³ The first expert, Dr. Dwight Adams of the FBI laboratory, testified to the procedure used for obtaining a DNA sample from a vaginal swab and analyzing it. He said that the FBI used the RFLP technology and that this type of analysis had been used "in the medical field for the diagnosis of cancer and other diseases since the late 1970s or early 1980s and that the FBI began to use DNA for identification purposes in the mid-1980s."¹⁹⁴ With regard to the accuracy of the procedure, he stated that the FBI had a protocol for the analysis of RFLP that was followed all the way through and never varied.¹⁹⁵ He testified that he routinely is subject to proficiency tests and that he "has yet to

¹⁸⁸ The *Harris* court said it was "unwilling, at this time, to embrace conclusively this 'extraordinarily powerful and promising innovation.'" *Harris*, 846 S.W.2d at 681 (quoting *United States v. Two Bulls*, 918 F.2d 56, 59 (8th Cir. 1990), *appeal dismissed*, 925 F.2d 1127 (1991)).

¹⁸⁹ The court has stated that, at least for now, it will consider DNA evidence on a case-by-case basis. *See id.*, *Mitchell*, 908 S.W.2d at 101.

¹⁹⁰ *Harris*, 846 S.W.2d at 679.

¹⁹¹ *Id.* (quoting Dr. Dwight Adams, special agent in the DNA Analysis Unit).

¹⁹² The hearing was held on October 3, 1990. *Id.* at 680. This would have been before much of the controversy about DNA, including the NRC report of 1992 (*see* NATIONAL RESEARCH COUNCIL, *supra* note 2) and the NATURE (*see* Lander, *supra* note 126) article from 1992, in which the FBI apparently backed away from some of its assumptions concerning the statistical calculations.

¹⁹³ *See Harris*, 648 S.W.2d at 680.

¹⁹⁴ *Id.*

¹⁹⁵ *See id.*

make a mistake on a test.”¹⁹⁶ He also opined that the statistical method used was “very conservative.”¹⁹⁷

The other expert witness was Dr. David Goldman, Chief of Genetics Research at the National Institute of Health and an expert in molecular biology and population genetics. He testified that the DNA testing procedures used by the FBI were variations of procedures that were in very wide use, that there were no substantial differences in the tests, and that they were “extraordinarily accurate.”¹⁹⁸ He noted that these tests have undergone extensive peer review and are widely accepted in the scientific community and that the frequency calculations are “conservative and objective.”¹⁹⁹

The trial court concluded that since thirty-eight states had accepted this procedure and since DNA testing was widely accepted by the scientific community as a “reliable and accurate technological procedure, its results were admissible.”²⁰⁰ Concluding that the trial court had not abused its discretion in letting the evidence in, the court nevertheless held that since DNA profiling is a relatively new procedure and “has been the subject of controversy in both the legal and scientific fields,”²⁰¹ it would be prudent to determine admissibility on a case-by-case basis.²⁰²

The next case was *Mitchell*, decided in 1995 after more national controversy on the DNA issue. The Kentucky Supreme Court refused to rule that DNA is either not admissible per se or that it is admissible per se, still opting for a case-by-case analysis.²⁰³ The court stated that *Daubert* required a pretrial hearing for the judge to determine whether “the reasoning or methodology underlying the testimony is scientifically valid and whether that reasoning or methodology can be applied to the facts in issue.”²⁰⁴

¹⁹⁶ *Id.*

¹⁹⁷ *Id.*

¹⁹⁸ *Id.*

¹⁹⁹ *Id.*

²⁰⁰ *Id.* at 681.

²⁰¹ *Id.* (citing *United States v. Two Bulls*, 918 F.2d 56, 58 (8th Cir. 1990), *appeal dismissed*, 925 F.2d 1127 (1991)). Of course, there was no issue of identity in the trial since the defendant had confessed to the police and had even testified at the trial admitting to the rape and burglary. The only issue was sodomy, where DNA evidence was not implicated. That may have been why the defense called no witnesses to fight the admission of DNA evidence. *See id.*

²⁰² *See id.*

²⁰³ *See Mitchell v. Commonwealth*, 908 S.W.2d 100, 101 (Ky. 1995).

²⁰⁴ *Id.* (citing *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579

The court stated that the requirement that the testimony "pertain to 'scientific knowledge' establishes a standard of 'evidentiary reliability' " ²⁰⁵ A trial court should consider (1) "whether the scientific knowledge being presented has been tested, whether it has been subject to peer review, and publication"; (2) the "evidence's known rate of error"; and (3) "whether the evidence has a particular degree of acceptance in the relevant community" ²⁰⁶

In *Mitchell*, as in *Harris*, the defendant had confessed to the police. ²⁰⁷ Perhaps the confession helped authenticate the match by the laboratory and acted as a sufficient test of the procedure. At any rate, both Kentucky cases involved instances where the defendant had confessed, thus making the DNA evidence superfluous. In *Mitchell* the court did not discuss the specific details of the DNA evidence as it did in *Harris*, but simply concluded that there was no abuse of discretion under the requirements of *Daubert*. ²⁰⁸

The Kentucky Supreme Court is certainly aware of the controversy over this type of evidence, having cited cases in *Harris* from the beginning of the controversy ²⁰⁹ A true test of admissibility will occur only when DNA evidence plays a major role in a case and there is expert testimony on both sides. Only then can the court focus on all of the controversial issues to be decided.

It should be realized that it has been less than one decade since forensic DNA jumped into the legal arena. ²¹⁰ It was touted in the beginning as the "greatest boon to forensic medicine and law since fingerprinting," ²¹¹ with claims like "disputing the technology is like disputing the law of gravity," ²¹² and statistical estimates of a random

(1993)).

²⁰⁵ *Id.* (quoting *Daubert*, 509 U.S. at 579).

²⁰⁶ *Id.* at 102 (quoting LESLIE ABRAMSON, KENTUCKY PRACTICE: CRIMINAL PRACTICE AND PROCEDURE § 27.83 n.2 (Supp. 1994)).

²⁰⁷ *See id.*

²⁰⁸ *See id.*

²⁰⁹ *See Harris v. Commonwealth*, 846 S.W.2d 678, 681 (Ky. 1992) (citing *United States v. Two Bulls*, 918 F.2d 56, *appeal dismissed*, 925 F.2d 1127 (8th Cir. 1991); *Commonwealth v. Curnin*, 565 N.E.2d 440 (Mass. 1991)).

²¹⁰ *See NATIONAL RESEARCH COUNCIL, supra* note 2, at 1 (stating that the FBI began using DNA in cases in 1988. The first appellate decision on DNA was *Andrews v. State*, 533 So.2d 841 (Fla. Dist. Ct. App. 1988)).

²¹¹ Hoeffel, *supra* note 22, at 466 (citing Jean L. Marx, *DNA Fingerprinting Takes the Witness Stand*, 240 SCIENCE 1616 (1988)).

²¹² *Id.* (citing Debra Cassens Moss, *DNA — The New Fingerprints*, A.B.A.

match going into the millions or billions.²¹³ Yet, after lengthy hearings, some of the tests have been shown to be badly flawed.²¹⁴ There has also been a considerable amount of controversy concerning the statistical evidence before and after the NRC recommended a major change concerning the product rule in 1992.²¹⁵ Had the NRC's ceiling principle been applied to the cases where the frequency rates were stated to be in the millions or billions, the probability of a random match would have been considerably different.²¹⁶

The NRC recommended many changes in 1992, including accreditation of testing laboratories and sample splitting, long after many courts had permitted the use of DNA evidence without such safeguards. Many states have enacted statutes requiring DNA evidence to be admitted, even without expert testimony to accompany it.²¹⁷ The NRC has criticized this type of blanket statute. There is a serious lack of consistency among the players in the DNA field. Since the huge numbers can be very prejudicial, it is important that scientists achieve a consensus at some point. A sampling of some of the cases in other jurisdictions on this controversial subject shows the wisdom of the Kentucky Supreme Court in adopting a wait-and-see, case-by-case attitude.

B. Cases from Other States That Have Admitted DNA Evidence

While it is true that many states have permitted the introduction of DNA evidence, that fact alone is not dispositive of any issue. Many of those cases involved the ill-conceived statutes criticized by the NRC,²¹⁸ while in others the defense either did not object to the admission of DNA evidence or called no expert witnesses to rebut the prosecution's evidence. In addition, the methodology used for a specific case may be different from that used for another. That fact should be considered, in light of *Daubert* and *Mitchell*, in determining if the specific technique meets the standards of admissibility. It is not simply DNA that is at issue, but the particular technique used by the testing laboratory, the database

J., May 1, 1988, at 66, 69-70 (paraphrasing David Housman, Professor of Biology, Massachusetts Institute of Technology)).

²¹³ See *supra* note 16.

²¹⁴ See *infra* notes 242-50 and accompanying text.

²¹⁵ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 82.

²¹⁶ The ceiling principle is much more conservative than the standard product rule. See *id.* at 83.

²¹⁷ See *supra* note 95.

²¹⁸ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 52.

used to find a match, and the validity of the statistical calculations.²¹⁹ Accordingly, the decisions of other courts that have permitted the use of DNA evidence are no more controlling than those that have rejected it. A study of the individual cases shows, however, that there exists much controversy within the field. Significant scientific controversy should be settled by scientists, not courts, and the subject of the controversy should not be admitted into evidence until the controversy is settled.²²⁰

In *Andrews v. State*,²²¹ DNA evidence, including statistical calculations showing the odds of a random match as being one in 800 million, was deemed admissible.²²² That court found persuasive the fact that DNA had been used for years in the diagnosis and treatment of diseases. The case, decided in 1988, predated almost all of the controversy surrounding the use of DNA evidence.²²³ Another case permitted DNA evidence and statistical analysis showing odds of one in 234 billion of a random match.²²⁴ In these cases, the NRC recommendation in 1992 concerning the use of a ceiling principle would have lowered these odds by millions and billions, respectively.²²⁵

*Washington v. Copeland*²²⁶ admitted both DNA evidence and statistical calculations, holding that the standard for admissibility in Washington was still the general acceptance test of *Frye*, even though Washington had a statute identical to the Federal Rule of Evidence interpreted in *Daubert*, and the case was decided long after *Daubert*.²²⁷ The court believed that judges “do not have the expertise required to

²¹⁹ See NATIONAL RESEARCH COUNCIL, *supra* note 2, at 52.

²²⁰ See *Reed v. State*, 391 A.2d 364, 371 (Md. 1978) (opining that courts should be reluctant to resolve the disputes of science. “It is not for the law to experiment but for science.”) (citing *State v. Cary*, 239 A.2d 680, 684 (N.J. Super. Ct. Law Div. 1968)).

²²¹ *Andrews v. State*, 533 So.2d 841 (Fla. Dist. Ct. App. 1988).

²²² This was the first appellate court to approve the use of DNA-typing evidence in a criminal case. See *Bennett*, *supra* note 18, at 141.

²²³ The *Castro* decision, which was the first case to reject DNA evidence, was decided in 1989. See *People v. Castro*, 545 N.Y.S.2d 985 (Sup. Ct. 1989). The Hoeffel Note, see *supra* note 22, which discussed many significant problems with DNA evidence, was published in 1990.

²²⁴ See *Martinez v. State*, 549 So.2d 694 (Fla. 1989).

²²⁵ See NATIONAL RESEARCH COUNCIL, *supra* note 2.

²²⁶ *State v. Copeland*, 922 P.2d 1304 (Wash. 1996).

²²⁷ See *id.* at 1314-15.

decide whether a challenged scientific theory is correct' ”²²⁸ and added that the court does not itself assess the validity of scientific evidence.²²⁹

United States v. Bonds,²³⁰ decided by the United States Court of Appeals for the Sixth Circuit, is further illustrative of the DNA problem. The trial court allowed DNA evidence in, then a year after the convictions and while the case was on appeal, the NRC published its book with recommendations and criticisms of the current procedures.²³¹ Affirming the trial court's decision to permit the introduction of DNA evidence, the Sixth Circuit refused to permit consideration of the NRC book in the appeal and ordered references thereto to be struck from the appellant's brief.²³² This case, therefore, is of limited significance since the NRC recommendations will be relevant in any case arising after their promulgation.

In *Bonds*, using a database of its own agents,²³³ the FBI, in April 1989, originally calculated the odds of a random match as being one in 270,000.²³⁴ Thereafter, in May 1990, the FBI modified its procedures and revised its match estimate to one in 35,000. The latter was used in court.²³⁵ The standard for admissibility at the time of the trial was FRE 702, before the Supreme Court interpreted it in *Daubert*.²³⁶ *Daubert* was decided while the appeal was pending, so the appellate court examined the evidence from the hearing and applied the rules of *Daubert* to it. The appellate attorneys, however, were not provided an opportunity to brief the new issues.²³⁷

United States v. Bonds is a perfect example why the Supreme Court of Kentucky has been wise to adopt a wait-and-see approach. The entire DNA profiling process was undergoing change before, during, and after

²²⁸ *Id.* at 1312 (quoting *State v. Cauthron*, 846 P.2d 502, 505 (Wash. 1993), partially abrogated by *State v. Copeland*, 922 P.2d 1304 (1996)).

²²⁹ *See id.*

²³⁰ *United States v. Bonds*, 12 F.3d 540 (6th Cir. 1993).

²³¹ *See* NATIONAL RESEARCH COUNCIL, *supra* note 2.

²³² *See Bonds*, 12 F.3d at 551-53.

²³³ The database consisted of 225 randomly chosen Caucasian agents. *See id.* at 551 n.5.

²³⁴ The FBI had just begun using DNA in case work shortly before this, in late 1988.

²³⁵ *See Bonds*, 12 F.3d at 550 n.3, 551.

²³⁶ The trial occurred in 1991, one year before the NRC report was released. *See* NATIONAL RESEARCH COUNCIL, *supra* note 2.

²³⁷ The case was argued in December of 1992 and decided in December 1993, with rehearing denied in February 1994. *See Bonds*, 12 F.3d at 540.

the trial, with more changes arising during the appeal. No procedure could be deemed "generally accepted" by the scientific community because numerous changes were occurring rapidly.²³⁸

Another issue of concern arises when the published protocol for profiling DNA is not followed by a laboratory. Is the result still reliable? Does the procedure used still pass the "general acceptance" test? The more specific issue is whether this goes to the admissibility of the profiling evidence or its weight. The federal circuits have split on this issue, with the Eighth Circuit ruling that it goes to the admissibility of the evidence,²³⁹ while the Ninth Circuit holds that it only goes to its weight.²⁴⁰ *Daubert* does not provide any guidance in resolving this issue.²⁴¹

C. Cases From Other States That Have Refused Admission

1. Refusal to Admit All DNA Evidence

The only cases that have rejected DNA evidence outright have done so on the basis of faulty technique, not because the theory or scientific validity of DNA profiling was in doubt.²⁴² In *People v. Castro*, during the twelve-week hearing to determine the admissibility of DNA evidence that showed a match, the state's expert witness from the testing laboratory testified that, among other problems, the laboratory continued to use a probe even though it had been contaminated with bacteria and that was known early in the process.²⁴³ In addition, in order to call a match, the laboratory simply ignored extra bands that were observed in one sample, not testing them to see if they were the result of contamination. Based on the problems with the specific work done by the laboratory in that instance, DNA evidence was rejected by the court, although its use was not ruled out in general.²⁴⁴

²³⁸ The case exemplifies the problem with announcing a rigid rule of law where technology and procedures are undergoing fairly rapid changes.

²³⁹ See *United States v. Martinez*, 3 F.3d 1191 (8th Cir. 1993).

²⁴⁰ See *United States v. Chiscilly*, 30 F.3d 1144 (9th Cir. 1994).

²⁴¹ See James E. Starrs, *Recent Developments in Federal and State Rules Pertaining to Medical and Scientific Expert Testimony*, 34 DUQ. L. REV. 813, 837 (1996).

²⁴² See Bennett, *supra* note 18, at 170.

²⁴³ See *People v. Castro*, 545 N.Y.S.2d 985 (Sup. Ct. 1989).

²⁴⁴ See *id.*

In *State v. Schwartz*,²⁴⁵ DNA evidence showing a match was not admitted because the testing laboratory had not conformed with appropriate quality control standards.²⁴⁶ One problem cited by the court was that a match call was made on certain samples even though the band patterns did not fit the laboratory's match standards. Further, the court pointed out that during blind proficiency tests, the laboratory had incorrectly identified two of forty-four samples as coming from the same subject, which, according to some experts, was above the acceptable error rate threshold. The laboratory had also failed to publish data concerning its methodology.²⁴⁷

Failure to offer any evidence of general scientific acceptance of the protocol of the RFLP methodology and failure to show that the statistical analysis was performed in accordance with accepted methodology were fatal in *People v. Venegas*.²⁴⁸ Similarly, in *People v. Keene*,²⁴⁹ disagreement by expert witnesses as to whether a method used by the laboratory to correct for band shifting was generally accepted in the molecular genetics community prevented admissibility of DNA evidence, where no other forensics laboratory used the procedure.²⁵⁰

The fact that few courts have rejected DNA evidence, although it has been offered in many cases, reflects the relative ease with which prosecutors may introduce testimony that a match exists. The science on the actual profiling does not appear to be in dispute, and either there is very little controversy concerning a particular methodology, or the issues simply have not been raised in the trial. That leaves population genetics as the primary area of dispute.

2. *Refusal to Admit Evidence of Population Genetics*

By far the greatest concern expressed by courts dealing with the complexities of DNA profiling has been in the area of statistical analysis

²⁴⁵ *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989).

²⁴⁶ *See id.* at 428.

²⁴⁷ *See id.* at 426-27.

²⁴⁸ *See People v. Venegas*, 36 Cal. Rptr. 2d 856, 863-64 (Ct. App.), review granted, 39 Cal. Rptr. 2d 408 (1995). But see *People v. Givens*, 61 Cal. Rptr. 2d 816, 824 & n.12 (Ct. App.) (noting that several decisions of the California Court of Appeal had concluded that use of the product rule was no longer in doubt and that the California Supreme Court had granted review in all of those cases), review granted, 64 Cal. Rptr. 2d 577 (Cal. 1997).

²⁴⁹ *People v. Keene*, 591 N.Y.S.2d 733 (Sup. Ct. 1992).

²⁵⁰ *See id.* at 740.

of the frequency of a random match. Since the release of the NRC report, many courts have deemed such evidence inadmissible.²⁵¹

In *State v. Pennell*,²⁵² the court refused to permit evidence of the frequency of a DNA pattern because the database from which the evidence was derived had not been shown to be in Hardy-Weinberg equilibrium.²⁵³ The possibility of a random match was one in 180 billion, according to the laboratory, but if the database was not in Hardy-Weinberg equilibrium, the laboratory's use of probability statistics could not be considered to be based on reliable scientific assumptions.²⁵⁴

In *State v. Bible*,²⁵⁵ the court stated that it was indisputable that the statistical method for calculating the frequencies of random matches was not accepted by the scientific community and that the trial court had erred by admitting probability testimony based on the product rule.²⁵⁶ Some courts have reversed cases based on the recommendations of the NRC report, ruling that the report indicated a lack of general acceptance of the then-current method of interpreting the data.²⁵⁷ There have been several other cases where evidence of low frequency rates based on the product rule was not allowed.²⁵⁸

²⁵¹ See Scheck, *supra* note 67, at 1965 n.20 (stating that "the overwhelming majority of appellate decisions in *Frye* jurisdictions [since the publication of the NRC report] have rejected methods used by the major forensic laboratories for making statistical estimates").

²⁵² *State v. Pennell*, No. Crim. A. W88-12-0051, 1989 WL 167430 (Del. Sup. Ct. Nov. 6, 1989).

²⁵³ See *id.* at *1.

²⁵⁴ See *id.* at *5.

²⁵⁵ *State v. Bible*, 858 P.2d 1152 (Ariz. 1993).

²⁵⁶ See *id.* at 1188 n.27 (citing *People v. Barney*, 10 Cal. Rptr. 2d 731, 744 (Ct. App. 1992), *abrogated by* *People v. Wilds*, 37 Cal. Rptr. 2d 351 (Ct. App.), *review granted*, 39 Cal. Rptr. 2d 406 (1995)).

²⁵⁷ See, e.g., *People v. Wallace*, 17 Cal. Rptr. 2d 721 (Cal. Ct. App. 1993); *Barney*, 10 Cal. Rptr. 2d at 731. *But see* *People v. Wilds*, 37 Cal. Rptr. 2d 351, 352 (Cal. Ct. App.) (stating, in upholding the use of DNA evidence, that the "blight [that] had come over the landscape of general acceptance," as discussed in *Barney*, "ha[d] now passed"), *review granted*, 39 Cal. Rptr. 2d 406 (1995).

²⁵⁸ See *People v. Venegas*, 36 Cal. Rptr. 856 (Ct. App.), *review granted*, 39 Cal. Rptr. 2d 408 (1995); *State v. Sivri*, 646 A.2d 169 (Conn. 1994); *Commonwealth v. Curnin*, 565 N.E.2d 440 (Mass. 1991); *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989); *State v. Vandebogart*, 616 A.2d 483 (N.H. 1992); *State v. Cauthron*, 846 P.2d 502 (Wash. 1993), *partially abrogated by* *State v. Copeland*, 922 P.2d 1304 (1996). *But see* *Caldwell v. State*, 393 S.E.2d 436, 444 (Ga. 1990); *People v. Mohit*, 579 N.Y.S.2d 990, 999 (Sup. Ct. 1992) (taking the

CONCLUSION

The Supreme Court of Kentucky's decision to take a wait-and-see attitude shows an understanding of the great amount of controversy that has surrounded the new forensic adaptation of medical and diagnostic analysis of DNA. The NRC, in both its 1992 report and 1996 report, made several recommendations for laboratories conducting DNA testing. One of the most significant aspects of both reports is the suggestion that courts disallow any evidence from an unaccredited laboratory.²⁵⁹ If the evidence shows that a laboratory has not complied with the recommendations, the Kentucky Supreme Court should refuse to permit DNA evidence.

The Kentucky high court's patience in avoiding a definitive ruling is commendable in view of the magnitude of the controversy that has raged around this highly complex issue. The NRC itself has said that the technology of DNA profiling is always changing. To say that DNA evidence is admissible in all cases without specifying which test was used, whether the protocol was properly followed, or whether the database was shown to be in Hardy-Weinberg equilibrium is simply to ignore the issues. Until all of the issues are resolved by the scientists in the field, a case-by-case approach is the only reasonable way to handle the question of whether DNA evidence is admissible, because rapidly changing technology makes the accuracy of one test not necessarily a true measure of the accuracy of all procedures.²⁶⁰

unusual position of allowing in DNA testimony if the probability figure was calculated based on "the most conservative of all estimates").

²⁵⁹ See *Bureau of National Affairs, Inc.*, *supra* note 179, at 204.

²⁶⁰ At the time of publication, the FBI crime lab's DNA unit had recently announced that the agency's techniques for matching DNA samples to a single individual have matured to the point where an FBI expert witness can state flatly, without qualification, that there is a DNA match. This conclusiveness is shown when the probability exceeds one in 260 billion. The Earth's population is approximately 5.8 billion. The FBI currently uses six different genetic pattern sites, with two more to be added next year. Each new site increases the odds that a DNA match will be unique to one individual and exclude others from possibility. A new technique called chemiluminescence allows DNA to be processed in two weeks instead of the previous three-month lag time. Paul Recer, *FBI Says DNA Evidence Technique Now Improved to Certainty*, THE ASSOCIATED PRESS, Nov. 12, 1997.